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## Verbenone Bubble Caps Ineffective as a Preventive Strategy Against Mountain Pine Beetle Attacks in Ponderosa Pine

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Verbenone capsules were stapled to trees in mountain pine beetle-infested stands of ponderosa pine at densities of 10, 20, 40, and 68 capsules per acre. Mean numbers of infested trees were not significantly different among treatments. Either the verbenone is not effective in repelling attacks or the formulation in the capsules needs to be modified to enhance its effectiveness. Verbenone capsules were not effective enough to be used in a preventive strategy.

**Keywords:** Mountain pine beetle, *Dendroctonus ponderosae*, pheromones

Verbenone capsules have been tested extensively against the mountain pine beetle (MPB), *Dendroctonus ponderosae* Hopkins, in the West. In British Columbia in 1987, verbenone treatments in the presence of tree baits decreased the number of mass-attacked trees by 74% in comparison to stands with only the baits (Lindgren et al. 1989). When tree baits were omitted in a second test, the number of mass-attacked trees was reduced by 75%, although the reductions were not significantly different from reductions in the controls (Lindgren et al. 1989). Similar tests in Idaho showed differences in treatments when verbenone and tree baits were used in tandem but no differences with verbenone alone (Amman et al. 1989).

Initial success with the verbenone in these early tests led to a West-wide test of verbenone capsules under the same treatment design in 1988. Results were mixed; some tests showed positive results, others failed to confirm the promise of verbenone. In the Intermountain Region, verbenone significantly reduced the number of

mass-attacked trees in lodgepole pine, *Pinus contorta* Douglas ex Loud. (Gene Amman, personal communication). In ponderosa pine, *P. ponderosa* Lawson, numbers of infested trees were not significantly different between the treatments and control (Ken Gibson, personal communication). In Colorado and South Dakota, four different densities of verbenone capsules failed to significantly change the number of attacked trees in ponderosa pine (Bentz et al. 1989). However, unseasonably warm temperatures may have affected the verbenone, causing it to change chemically and not function as expected. Because the effectiveness of the verbenone may have been compromised in 1988, the study was repeated in 1989 to evaluate the effectiveness of different densities of verbenone capsules in reducing the number of MPB-infested ponderosa pine.

### Methods

The verbenone capsules were field-tested on the Black Hills National Forest in South Dakota. The study area, located about 9 miles northwest of Custer in the White House Gulch and Bear Basin drainage, was the same area Bentz et al. (1989) used for the 1988 tests in the Black Hills. MPB populations in 1989 were in outbreak status but the population trend was static. Tree mortality averaged 4.7 trees per acre.

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During June 20–22, 1989, forty 2.5-acre plots were laid out in the study area. Plots were installed in series of 5 to accommodate the five treatments in each replication: 0 (control), 10, 20, 40, and 68 verbenone capsules per acre. Plots within each replicate were near each other and selected to minimize potential variability in the results from differences in stand conditions and topographic features. Each plot contained at least ten 1988 MPB-infested trees.

Each plot was completely inventoried before the verbenone capsules were set out. All ponderosa pine greater than 5-inches diameter at breast height (d.b.h.) were recorded in 1-inch diameter categories and classified as: green, uninfested; 1988 mass-attacked; 1988 pitchout; 1988 strip-attacked; or nonhost species. Trees killed by the MPB before 1988 were ignored.

Verbenone capsules were set out on the plots July 11–13, 1989. Capsules were set out on a grid pattern with approximate equidistant spacing between adjacent capsules. Spacing varied from 25.8 to 66 feet between adjacent capsules, depending on the treatment. Capsules were stapled 5–6 feet aboveground on the north side of the tree or shrub closest to the grid point.

To determine the rate of verbenone evaporation and changes in the verbenone concentration in the capsules, 35 capsules were stapled to 7 trees in a dense stand about 0.5 mile from the closest plot. Seven capsules, one from each tree, were removed periodically and the capsule's contents subjected to quantitative and qualitative analyses in a Forest Service Laboratory in Corvallis, Oregon. Capsules were removed 7, 18, 36, and 70 days after installation.

Plots were resurveyed for 1989 MPB-attacked trees during September 19–21, 1989. All green trees in the plots were classified in 1-inch diameter classes as: uninfested, mass-attacked, pitchout, or strip-attacked in 1989.

The total numbers of 1989 mass-attacked, pitchout, and strip-attacked trees were combined and subjected to randomized block analysis of variance to determine significant differences among treatments ( $\alpha = 0.05$ ). Initially, variance for each treatment was tested for homogeneity using the Levene statistic and was found to be heterogeneous ( $\alpha = 0.05$ ). Welch's test (Milliken and Johnson 1984) was, therefore, used to test whether attack levels varied among verbenone treatments. The combined total for the three MPB-attack categories was used because it reflects the most accurate measure of beetle pressure. We recognized that mass-attacked trees differ from pitchouts and strip-attacks in the number of attacking beetles, thus leading to possible erroneous conclusions regarding the results. However, we examined the relative proportions of each category of MPB-attacked trees in each replicate to determine if unequal proportions occurred and found the proportions were not disproportionate among treatments.

## Results and Discussion

Numbers of infested trees for all infestation categories combined were not significantly different among treat-

ments ( $p = 0.37$ , means followed by the same letter are not significantly different,  $\alpha = 0.05$ ).

Treatment	$\bar{X} \pm SD$
0 (Control)	29.1 $\pm$ 39.1a
10 caps/acre	14.4 $\pm$ 12.4a
20 caps/acre	11.8 $\pm$ 13.1a
40 caps/acre	7.5 $\pm$ 9.8a
68 caps/acre	5.6 $\pm$ 9.8a

Although mean treatment effect appeared inversely proportional to the density of verbenone capsules, the variation within treatments was too great to consider any differences in the means significant. The means for respective treatments in our study are almost identical to the means of 35, 10, 14, 8, and 5 infested trees per treatment reported by Bentz et al. (1989) for the same respective treatments.

In 1988, the treatments were thought to be compromised by above-average temperatures which depleted capsule contents faster than expected and also possibly caused chemical changes in the contents (Bentz et al. 1989). In the period between the 1988 and 1989 tests, the manufacturer changed from a transparent capsule to an opaque capsule, thereby reducing the possibility of chemical changes in the verbenone caused by direct sunlight. Also, summer temperatures were nearer normal in 1989 and, therefore, did not exert as much evaporative demand on the capsules. Capsule contents decreased only about 20% during the summer and the percentage of verbenone did not drop below 85% (table 1).

Despite these improvements, treatment effect did not change in 1989 and results were essentially the same as in 1988. Either the verbenone is not effective in reducing MPB attack in ponderosa pine or the contents of the capsules need modification to enhance effectiveness. The sphere of influence of verbenone produced by the MPB during the natural attack period is probably limited to the ambient air space immediately adjacent to the attacking beetle or, in the case of an infested tree, the space immediately adjacent to the tree (possibly 1–2 feet from the bole). If verbenone reduced attacks much beyond this sphere of influence, adjacent trees would not be attacked. Therefore, the infestation of trees adjacent to a tree with a verbenone capsule can be understood. However, the posttreatment survey indicated that a number of trees with verbenone capsules were attacked. This

Table 1.—Residual amounts of verbenone in capsules during the summer of 1989.

Days after installation	Weight (mg.)		Percent verbenone
	Capsule fluid	Verbenone	
0	787	724	92
7	753	648	86
18	708	651	92
36	672	571	85
70	652	544	87

suggests some capsules were not repelling MPB and the composition of the capsule contents may need to be changed.

Based on our results, verbenone capsules were not effective enough to be used in a preventive strategy protecting susceptible ponderosa pine trees from MPB attack.

### Literature Cited

- Amman, G. D.; Thier, R. W.; McGregor, M. D.; Schmitz, R. F. 1989. Efficacy of verbenone in reducing lodgepole pine infestation by mountain pine beetles in Idaho. *Canadian Journal of Forest Research*. 19: 60-62.
- Bentz, B.; Lister, C. K.; Schmid, J. M.; Mata, S. A.; Rasmussen, L. A.; Haneman, D. 1989. Does verbenone reduce mountain pine beetle attacks in susceptible stands of ponderosa pine? Res. Note RM-495. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 4 p.
- Lindgren, B. S.; Borden, J. H.; Cushon, G. H.; Chong, L. J.; Higgins, C. J. 1989. Reduction of mountain pine beetle (Coleoptera: Scolytidae) attacks by verbenone in lodgepole pine stands in British Columbia. *Canadian Journal of Forest Research*. 19: 65-68.
- Milliken, G. A.; Johnson, D. E. 1984. Analysis of messy data. Vol. 1: Designed experiments. Belmont, CA: Lifetime Learning Publications.

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